CEVE 311 / MECH 311 Mechanics of Solids
Spring 2013
Herzstein Hall 210 TR 1:00 to 2:15 pm

Instructor: Dr. Steven Wilkerson
Dept. of Civil & Environmental Engineering
Haynes Whaley Associates, Inc.
713-868-1591 (o); 832-969-8641 (c)
stevew1@rice.edu; Steve.Wilkerson@hayneswhaley.com

Office Hours: TR – 2:15 to 3:00 pm, or by appointment

Recitation Session: Thursday 7 to 9 pm Ryon Bldg. 201

Course Content: Analysis of stress and deformation of solids with applications to bars, beams, and columns. Study of engineering properties of materials. Applying equilibrium, compatibility, and force-deformation relationships to structural elements. Introduction to flexibility and stiffness method of structural analysis.

Prerequisite: CEVE/MECH 211

Textbook: CEVE / MECH 311: Mechanics of Materials
by Roy R. Craig, Jr.,
Publisher: Wiley; 3rd edition
ISBN-978-0-470-48181-3

Grading Policy:		
	Home Work	– 20 %
	Pop Quiz(s)	– 20 %
	First Exam	– 20 %
	Second Exam	– 20 %
	Final Exam	– 20 %

Homework Policy:

Homework assigned during a week is due the following Tuesday. Homework submitted late will receive partial grade at the discretion of the instructor.

Pop Quiz Policy:

Quiz will be assigned at any time during any class (prior notice may be given for some quizzes and for some quizzes no prior notice may be given, i.e., pop-quiz may be

given at any time during class {beginning or middle or end of the class}). Normally, if a student misses a quiz makeup quiz will not be given. However, if a student has a valid reason for missing the quiz, and can provide it in written form, then a makeup quiz will be given at the discretion of the instructor.

ADA

If you have a documented disability that will impact your work in this class, please contact me to discuss your needs. Additionally, you will need to register with the Disability Support Services Office in the Ley Student Center. 713/348-5841; www.dss.rice.edu

Course Topics:

Stress, Strain, Mechanical Properties of Materials
Normal stress and strain; Mechanical properties of materials; Elasticity, inelasticity, and plasticity; Linear elasticity, Hooke's law, and Poisson's ratio; Shear stress and strain; Allowable stresses and allowable loads; Design for axial loads and direct shear

Axially Loaded Members, Axial Stress and Strain, Strain Energy
Stiffness and flexibility of bars; Changes in length of uniform and nonuniform bars; Statically indeterminate bars; Stresses on inclined sections; Strain energy; Nonlinear behavior and elastoplastic analysis; Design for axial loads

Torsion of Circular Bars, Nonuniform Torsion, Strain Energy
Torsion of circular bars; elastic and inelastic bars; Design for uniform and nonuniform torsion; Stresses and strains on inclined sections due to torsion; Statically indeterminate torsional members

Beams, Normal Stresses, Shear Stresses
Bending moments and shear forces; Normal stresses in beams; moment curvature relationship; flexure formula; Design of beams for bending stresses; Shear stresses in beams of rectangular sections and I-sections; Design of beams with eccentric axial load

Analysis of Stress and Strain, Mohr's Circle
Plane stress; principal stresses and maximum shear stresses; Mohr's circle for plane stress; Plane strain; principal strains and maximum shear strains; Mohr's circle for plane strain

Deflection of Beams
Integration method, Moment Area Method

Introduction to Analysis of Statically Indeterminate Beams
Analysis by the differential equation of the deflection curve; Method of superposition

Buckling and Stability of Columns
Buckling; critical load, critical stress

CEVE/ MECH 311 Course Objectives and Outcomes

Course Objectives:

The objective of 311 is to learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns. Detailed study of engineering properties of materials is also of interest. Fundamentals of applying equilibrium, compatibility, and force-deformation relationships to structural elements are emphasized. The students are introduced to advanced concepts of flexibility and stiffness method of structural analysis. The course builds on the fundamental concepts of engineering mechanics course (211). The students will:

1. Gain a fundamental understanding of the concepts of stress and strain by analysis of solids and structures
2. Study engineering properties of materials, force-deformation, and stress-strain relationship
3. Learn fundamental principles of equilibrium, compatibility, and force-deformation relationship, and principle of superposition in linear solids and structures
4. Analyze determinate and indeterminate axial members, torsional members, and beams, and determinate trusses to determine axial forces, torque, shear forces, and bending moments
5. Determine stress, strain, deformation of bars, trusses, and beams; stress and strain transformation
6. Learn the fundamental concepts of the method of superposition, flexibility method, and stiffness method as applied to problems involving statically determinate and indeterminate axial and torsional members, and beams
7. Be able to perform structural analysis by hand computations and by using computer software and design axial and torsional members, bolts, trusses, and beams

Course Outcomes:

Students successfully completing 311 course will have a clear and thorough understanding of the fundamental concepts of mechanics of solids and structures and basic analysis and design skills. The students will have the ability to perform stress, strain, force and deformation analysis by hand and by modern computer software based on stiffness method. The students will be able to or have:

1. Fundamental understanding of the concepts of stress and strain in mechanics of solids and structures and material properties
2. Apply the fundamental concepts of principle of superposition, equilibrium, compatibility, force-deformation, and stress-strain relationships to the solid and structural mechanics problems
3. Analyze determinate and indeterminate bars, beams, and determinate trusses to determine axial forces, torques, shear forces, and bending moments
4. Physical insight into distribution of stresses and strains in structural members by determining stress, strain, and deformation of bars, trusses, and beams, and performing stress and strain transformations
5. Basic understanding of the method of superposition, flexibility method, and stiffness method as applied to statically determinate and indeterminate axial and torsional members, and beams
6. The ability to design structural members given the dimensions, material properties such as force-displacement relationships, boundary conditions, loading, allowable stresses, and factor of safety
7. Perform structural analysis using computer software and document analysis results, write detailed assessments, and communicate findings